2500 Wilson Boulevard
Arlington, VA 22201-3834
(703) 907-7660
FAX (703) 907-7601

NATIONAL RADIO SYSTEMS COMMITTEE

1771 N Street, NW
Washington, DC 20036-2800
(202) 429-5346
FAX (202) 775-4981

DAB Subcommittee

EVALUATION OF THE iBiquity DIGITAL CORPORATION IBOC SYSTEM

Part 2 – AM IBOC

Appendix C

Revision #6c (Final) April 12, 2001

IBOC FIELD TEST PROCEDURES – AM BAND
OVERALL COMMENTS

1. The independent engineering consultant (TBD) will provide a detailed certification of the mobile test vehicle including the stationary test platforms.
2. Appendix A is a table and set of maps which describe the test stations and test routes which this procedure is to be conducted for. Note that the test routes depicted therein represent the best possible estimate of the routes to be used, and that accommodations may be made during the actual test run due to road construction, etc. Maps of the actual routes taken will be provided in the field test record.
3. IBOC receiver "point of loss of enhanced audio" and "point-of-blend" are established by the "mode" signal which is supplied by the receiver. IBOC receiver block error rate (BLER) is also observable.
4. Unless otherwise specified, the audio selections to be used as source material for desired and interfering channels will be "audio of opportunity," and, the source audio for analog reference recordings will be the same as that used for the corresponding IBOC digital audio recordings.
5. Digital recordings of analog and IBOC digital audio indicated by these procedures are for archival and/or subjective evaluation purposes. All such recordings will be made in the following format: uncompressed linear 16-bit digital audio sampled at 44.1 kHz, and will be suitable for transfer to CD to facilitate further analysis.
6. The host AM to digital power ratio used in the digital performance tests will also be used for the analog compatibility tests.
7. NRSC analog test receivers specified on pg. 5 will undergo the following characterization tests: [list TBD]
8. Test record will indicate direction of travel on all routes.
9. All radial routes will be driven to the IBOC point of failure (POF), that is, until the IBOC signal is fully blended to analog.
10. All radial routes will be run at day (between 2 hrs. after sunrise and 2 hrs. before sunset) and at night (between 2 hrs. after sunset and 2 hrs. before sunrise).
11. "Strip chart" data plots will be included in the test record for all test routes [*e.g.*, a plot from USADR phase 1 submission will be included here].
12. NRSC will participate in selection of specific field test audio cuts to be submitted for subjective evaluation in a TBD fashion.

IBOC FIELD TEST PROCEDURES – AM BAND
CALIBRATION

Test Group	Test & Impairment	TEST DESCRIPTION Notes: 1. This calibration will be performed for each test station.	Type of Evaluation	Test Results Data to be Recorded
A Calibration	1 Power (as needed)	1. Analog power will be read by station's existing test equipment. 2. Digital power will be determined using a spectrum analyzer.	Objective	Analog average power level Digital average and peak power levels
	2 Spectrum (daily)	1. Spectrum analyzer plots of the system RF will be taken at the output of the transmission system. 2. The spectrum analyzer settings will be with a peak hold of 10 minutes, video bandwidth greater than 10 kHz, RBW 300 Hz, and sweep span of 100 kHz in accordance with CFR 47§73.44. 3. Two plots of the spectrum will be made: one with and one without IBOC digital sidebands. 4. Test station modulation monitor readings will be recorded.	Objective	Daily power ratios and out-of-channel radiation monitored at combiner output
	3 Monitor (beginning of test period)	1. Test station occupied bandwidth characteristics will be established by the test crew using a spectrum analyzer in both "average" and "peak hold" modes.	Objective	Certification should be recorded in field test record
	4 Receiver antenna performance and data	1. A detailed description of the receiving antenna and RF distribution system will be included in the field test report. 2. If any active RF device is used, a full set of RF performance test results will be supplied with the report.	Objective	
	5 General	1. All test equipment will be certified to be in compliance with manufacturer's specifications and calibration schedules.	Objective	Calibration results

IBOC FIELD TEST PROCEDURES – AM BAND
DIGITAL PERFORMANCE

Test Group	Test & Impairment	TEST DESCRIPTION	Type of Evaluation	Test Results Data to be Recorded
		Notes: 1. Radials will be selected to demonstrate system performance under the following conditions: a) low interference and no grounded conductive structures b) low interference and grounded conductive structures c) single first adjacent interferer d) single second adjacent interferer e) high-tension power lines parallel to radial; ideally, power lines will pass within 1-2 miles of transmitter site f) power lines (not high-tension) overhead in urban areas 2. Radials will start within 2.0 miles of the transmitter (where possible) and extend beyond the edge of digital coverage. 3. Audio recordings of both the analog and digital received audio will be made. 4. Recordings of the test route will be made including GPS data, derived signal strength and adjacent channel signal strength. 5. For all tests, stations will broadcast their regular programming. 6. NRSC analog test receiver [#1] will be used for analog reception.		
B System performance	1 Low interference and low multipath	1. The undesired first adjacent analog signal should be at least 20 dB below the digital signal. 2. The undesired analog second adjacent D/U should not exceed a D/U of 0 dB in the test area.	Objective	Mode signal, various RF signal levels [see example plot]
			Subjective	Analog recordings (to be subjectively evaluated)
	2 1st-adjacent interference	1. 1st-adjacent interferer tests will be conducted in an area where the interfering signal is not greater than 15 dB below the desired signal.	Objective	Mode signal, various RF signal levels [see example plot]
			Subjective	Analog recordings (to be subjectively evaluated)
	3 2nd-adjacent interference	1. 2nd-adjacent interferer tests will be conducted in an area where the interfering signal is not greater than 0 dB below the desired signal.	Objective	Mode signal, various RF signal levels [see example plot]
			Subjective	Analog recordings (to be subjectively evaluated)

IBOC FIELD TEST PROCEDURES – AM BAND
ANALOG COMPATIBILITY

Test Group	Test & Impairment	TEST DESCRIPTION Notes: 1. Host compatibility tests (C.1) will be conducted at stations TBD. 2. 1st-adjacent compatibility tests (C.2) will be conducted at stations TBD.	Type of Evaluation	Test Results Data to be Recorded
C Compatibility	1 Host compatibility	1. Fixed compatibility tests will be conducted using all NRSC Test Receivers. 2. The IBOC digital sidebands should be switched on for 30 seconds and off for 30 seconds. This should be repeated twice. 3. Recordings will be made at 3 locations with strong desired signals, and as free as possible of other (undesired) strong signals, so as to maximize potential for host interference.	Objective	Mode signal, various RF signal levels [see example plot]
			Subjective	Analog recordings (to be subjectively evaluated)
	2 1st-adjacent compatibility	1. Fixed compatibility tests will be conducted using all test receivers. 2. Modulation of desired analog signal will conform to the NRSC standard AM mask (i.e. 10 kHz nominal audio bandwidth). 3. Test will be conducted at a point where the first adjacent signal is not greater than 15 dB below the desired analog signal. 3. Recordings will be made at 3 locations. At each location, the IBOC digital sidebands should be switched on for 30 seconds and off for 30 seconds. This should be repeated twice. If practical, the bandwidth of the analog portion of the interfering signal should be increase to ±10 kHz during the 30 second intervals when the digital sidebands are turned off.	Objective	Mode signal, various RF signal levels [see example plot]
			Subjective	Analog recordings (to be subjectively evaluated)

NRSC Analog Test Receivers			
Number	Make and Model	Type	Age in Years
1	Delphi Model: 09394139	Auto OEM	New
2	Pioneer Model: KEH-1900	Aftermarket	New
3	Sony Model: CFD-S32	Table Combo	New
4	Technics Model: SA-EX140	Home HiFi	New

Revision #6c (Final) April 12, 2001

NRSC IBOC DAB Evaluation - AM Field Test Stations

APPENDIX A

Table 1 – Test Condition Matrix (see notes below)

No.	Call Sign	Freq. (kHz)	Format	Location	Test Condition(s) (a)	(b)	(c)	(d)	(e)	(f)				Comments
1	WD2XAM	1660	Test	Cincinnati, OH	✔	✔				✔				
2	WWJ	950	News/talk	Detroit, MI	✔	✔	✔	✔		✔				
3	WTOP	1500	News/talk	Washington, DC	✔	✔	✔	✔	✔	✔				
4	KABL	960	Oldies ("MOL")	Oakland, CA	✔	✔	✔			✔				
				Number of stations with given test condition ➜	4	4	3	2	1	4				

Notes for Table 1:

1. Proponent will run at least 4 radials for each test station; radials will be run at day (between 2 hrs. after sunrise and 2 hrs. before sunset) and at night (between 2 hrs. after sunset and 2 hrs. before sunrise).
2. Proponent will supply maps of the test radials (with blend information) plotted against predicted analog coverage and strip charts for each station
3. Select radials will be extracted for further analysis and subjective evaluation (selection to be done by proponent in conjunction with independent testing facility and NRSC observer)
4. Test conditions (see Field Test Procedure, Test B Notes):
   a) low interference and no grounded conductive structures
   b) low interference and grounded conductive structures
   c) single first adjacent interferer
   d) single second adjacent interferer
   e) high-tension power lines parallel to radial; ideally, power lines will pass within 1-2 miles of transmitter site
   f) power lines (not high-tension) overhead in urban areas

Table 2. Station List for IBOC-to-analog Compatibility Testing

Compatibility Type	Station of Interest Format Location	Freq. (kHz) Channel	Interfering Station Format Location	Freq. (kHz) Channel	Interferer location	Station Spacing
Host	KABL	960				
Host	WTOP	1500				
First Adjacent	WTOP	1500	WNNN	1510		
First Adjacent	WTOP	1500	WWSM	1510		
First Adjacent	KABL	960	KANM	970		
Second Adjacent	WTOP	1500	WTRI	1520		
Second Adjacent	WTOP	1500	WPWC	1480		

Table 3. Station List for IBOC Performance Testing

Test Station Format Location	Freq. (kHz) Channel	Propagation & Testing Features	Significant Interferers†	Drive Routes
WD2XAM Test station Cincinnati, OH	1660	10.0 kW, 1 tower Daytime only (experimental)		
WWJ News/talk Detroit, MI	950	6 kW (day), 6 kW (night) DA2 5 towers		
WTOP News/talk Washington, DC	1500	50 kW (day/night) DA2 3 towers	Co-Channel Interference	
KABL Oldies ("MOL") Oakland, CA	960	5 kW (day/night) DA1 3 towers	1st Adjacent Interference	

†Due to limitations on station coverage, it is likely that interference will not be tested except during nighttime testing